What is claimed is:

1. A low-alloy heat-resistant steel comprising:

carbon in an amount of 0.20 to 0.35% by weight,

silicon in an amount of 0.005 to 0.35% by weight,

manganese in an amount of 0.05 to 1.0% by weight,

nickel in an amount of 0.05 to 0.3% by weight,

chromium in an amount of 0.8 to 2.5% by weight,

molybdenum in an amount of 0.1 to 1.5% by weight,

tungsten in an amount of 0.1 to 2.5% by weight,

vanadium in an amount of 0.05 to 0.3% by weight,

phosphorus in an amount not greater than 0.012% by weight,

sulfur in an amount not greater than 0.005% by weight,

copper in an amount not greater than 0.10% by weight,

aluminum in an amount not greater than 0.01% by weight,

arsenic in an amount not greater than 0.01% by weight,

tin in an amount not greater than 0.01% by weight,

antimony in an amount not greater than 0.003% by weight, and

the balance being iron and unavoidable impurities, and

containing a metallic structure having an austenitic grain size number in a range of from 3 to 6.

2. A low-alloy heat-resistant steel comprising:

carbon in an amount of 0.20 to 0.35% by weight,

silicon in an amount of 0.005 to 0.35% by weight,

manganese in an amount of 0.05 to 1.0% by weight,

nickel in an amount of 0.05 to 0.3% by weight,

chromium in an amount of 0.8 to 2.5% by weight,

molybdenum in an amount of 0.1 to 1.5% by weight,

tungsten in an amount of 0.1 to 2.5% by weight,

vanadium in an amount of 0.05 to 0.3% by weight,

cobalt in an amount of 0.1 to 3.5% by weight,

phosphorus in an amount not greater than 0.012% by weight,

sulfur in an amount not greater than 0.005% by weight,

copper in an amount not greater than 0.10% by weight,

aluminum in an amount not greater than 0.01% by weight,

arsenic in an amount not greater than 0.01% by weight,

tin in an amount not greater than 0.01% by weight,

antimony in an amount not greater than 0.003% by weight, and

the balance being iron and unavoidable impurities, and

containing a metallic structure having an austenitic grain size number in a range of from 3 to 6.

3. A low-alloy heat-resistant steel comprising:

carbon in an amount of 0.20 to 0.35% by weight,

silicon in an amount of 0.005 to 0.35% by weight,

manganese in an amount of 0.05 to 1.0% by weight,

nickel in an amount of 0.05 to 0.3% by weight,

chromium in an amount of 0.8 to 2.5% by weight,

molybdenum in an amount of 0.1 to 1.5% by weight,

tungsten in an amount of 0.1 to 2.5% by weight,

vanadium in an amount of 0.05 to 0.3% by weight,

at least one of niobium in an amount of 0.01 to 0.15% by weight, tantalum in an amount of 0.01 to 0.15% by weight, nitrogen in an amount of 0.001 to 0.05% by weight, and boron in an amount of 0.001 to 0.015% by weight,

phosphorus in an amount not greater than 0.012% by weight,

sulfur in an amount not greater than 0.005% by weight,

copper in an amount not greater than 0.10% by weight,

aluminum in an amount not greater than 0.01% by weight,

arsenic in an amount not greater than 0.01% by weight,

tin in an amount not greater than 0.01% by weight,

antimony in an amount not greater than 0.003% by weight, and

the balance being iron and unavoidable impurities, and

containing a metallic structure having an austenitic grain size number in a range of from 3 to 6.

4. A low-alloy heat-resistant steel comprising:

carbon in an amount of 0.20 to 0.35% by weight,

silicon in an amount of 0.005 to 0.35% by weight,

manganese in an amount of 0.05 to 1.0% by weight,

nickel in an amount of 0.05 to 0.3% by weight,

chromium in an amount of 0.8 to 2.5% by weight,

molybdenum in an amount of 0.1 to 1.5% by weight,

tungsten in an amount of 0.1 to 2.5% by weight,

vanadium in an amount of 0.05 to 0.3% by weight,

cobalt in an amount of 0.1 to 3.5% by weight,

at least one of niobium in an amount of 0.01 to 0.15% by weight, tantalum in an amount of 0.01 to 0.15% by weight, nitrogen in an amount of 0.001 to 0.05% by weight, and boron in an amount of 0.001 to 0.015% by weight,

phosphorus in an amount not greater than 0.012% by weight,

sulfur in an amount not greater than 0.005% by weight,

copper in an amount not greater than 0.10% by weight,

aluminum in an amount not greater than 0.01% by weight,

arsenic in an amount not greater than 0.01% by weight,

tin in an amount not greater than 0.01% by weight,

antimony in an amount not greater than 0.003% by weight, and

the balance being iron and unavoidable impurities, and

containing a metallic structure having an austenitic grain size number in a range of from 3 to 6.

5. A low-alloy heat-resistant steel according to claim 1, wherein said metallic structure mainly contains a bainite phase and a pro-eutectoid ferrite phase.

6. A low-alloy heat-resistant steel according to claim 2, wherein said metallic structure mainly contains a bainite phase and a pro-eutectoid ferrite phase.

7. A low-alloy heat-resistant steel according to claim 3, wherein said metallic structure mainly contains a bainite phase and a pro-eutectoid ferrite phase.

8. A low-alloy heat-resistant steel according to claim 4, wherein said metallic structure mainly contains a bainite phase and a pro-eutectoid ferrite phase.

9. A low-alloy heat-resistant steel according to claim 1, wherein said metallic structure contains a pro-eutectoid ferrite phase in a range of from 5 to 40% by volume.

10. A low-alloy heat-resistant steel according to claim 2, wherein said metallic structure contains a pro-eutectoid ferrite phase in a range of from 5 to 40% by volume.

11. A low-alloy heat-resistant steel according to claim 3, wherein said metallic structure contains a pro-eutectoid ferrite phase in a range of from 5 to 40% by volume.

12. A low-alloy heat-resistant steel according to claim 4, wherein said metallic structure contains a pro-eutectoid ferrite phase in a range of from 5 to 40% by volume.

13. A low-alloy heat-resistant steel according to claim 1, wherein said metallic structure contains a pro-eutectoid ferrite phase, and carbnitrides are finely dispersed into said pro-eutectoid ferrite phase.

14. A low-alloy heat-resistant steel according to claim 2, wherein said metallic structure contains a pro-eutectoid ferrite phase, and carbnitrides are finely dispersed into said pro-eutectoid ferrite phase.

15. A low-alloy heat-resistant steel according to claim 3, wherein said metallic structure contains a pro-eutectoid ferrite phase, and carbnitrides are finely dispersed into said pro-eutectoid ferrite phase.

16. A low-alloy heat-resistant steel according to claim 4, wherein said metallic structure contains a pro-eutectoid ferrite phase, and carbnitrides are finely dispersed into said pro-eutectoid ferrite phase.

17. A heat treatment method for a low-alloy heat-resistant steel, comprising the steps of:

heating a steel ingot to a range of from 1,000 to 1,100℃, which comprises carbon in an amount of 0.20 to 0.35% by weight, silicon in an amount of 0.005 to 0.35% by weight, manganese in an amount of 0.05 to 1.0% by weight, nickel in an amount of 0.05 to 0.3% by weight, chromium in an amount of 0.8 to 2.5% by weight, molybdenum in an amount of 0.1 to 1.5% by weight, tungsten in an amount of 0.1 to 2.5% by weight, vanadium in an amount of 0.05 to 0.3% by weight, and the balance being iron and unavoidable impurities;

cooling said steel ingot to a certain temperature in a range of from 900 to 700℃ by a spray-quenching and/or an air-blast quenching,

air cooling for from 5 minutes to 5 hours,

cooling again by at least one method of a spray-quenching, an air-blast quenching, and an oil quenching.

18. A heat treatment method for a low-alloy heat-resistant steel comprising the steps of:

heating a steel ingot to a range of from 1,000 to 1,100℃, which comprises carbon in an amount of 0.20 to 0.35% by weight, silicon in an amount of 0.005 to 0.35% by weight, manganese in an amount of 0.05 to 1.0% by weight, nickel in an amount of 0.05 to 0.3% by weight, chromium in an amount of 0.8 to 2.5% by weight, molybdenum in an amount of 0.1 to 1.5% by weight, tungsten in an amount of 0.1 to 2.5% by weight,

vanadium in an amount of 0.05 to 0.3% by weight, and the balance being iron and unavoidable impurities;

cooling said steel ingot to a temperature in a range of from 800 to 600℃ at an average cooling rate of 2℃/min or less; and

cooling to 300℃ at an average cooling rate in a range of from 2 to 15℃/min.

19. A heat treatment method according to claim 17, wherein said steel ingot further comprises at least one of niobium in an amount of 0.01 to 0.15% by weight, tantalum in an amount of 0.01 to 0.15% by weight, cobalt in an amount of 0.1 to 3.5% by weight, nitrogen in an amount of 0.001 to 0.05% by weight, and boron in an amount of 0.001 to 0.015% by weight.

20. A heat treatment method according to claim 18, wherein said steel ingot further comprises at least one of niobium in an amount of 0.01 to 0.15% by weight, tantalum in an amount of 0.01 to 0.15% by weight, cobalt in an amount of 0.1 to 3.5% by weight, nitrogen in an amount of 0.001 to 0.05% by weight, and boron in an amount of 0.001 to 0.015% by weight.

21. A heat treatment method according to claim 17, wherein said unavoidable impurities contain phosphorus in an amount not greater than 0.012% by weight, sulfur in an amount not greater than 0.005% by weight, copper in an amount not greater than 0.10% by weight, aluminum in an amount not greater than 0.01% by weight, arsenic in an amount not greater than 0.01% by weight, tin in an amount not greater than 0.01% by weight, and antimony in an amount not greater than 0.003% by weight.

22. A heat treatment method according to claim 18, wherein said unavoidable impurities contain phosphorus in an amount not greater than 0.012% by weight, sulfur in an amount not greater than 0.005% by weight, copper in an amount not greater than 0.10% by weight, aluminum in an amount not greater than 0.01% by weight, arsenic in an amount not greater than 0.01% by weight, tin in an amount not greater than 0.01% by weight, and antimony in an amount not greater than 0.003% by weight.

23. A turbine rotor comprising a low-alloy heat-resistant steel according to claim 1.

24. A turbine rotor comprising a low-alloy heat-resistant steel according to claim 2.

25. A turbine rotor comprising a low-alloy heat-resistant steel according to claim 3.

26. A turbine rotor comprising a low-alloy heat-resistant steel according to claim 4.